"SimNerv" - Simulation of sum-action potentials in the ischiadic nerve of the frog with a virtual physiology lab

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Medical students have to study different aspects of sum-action potentials (SAP's) in the ischiadic nerve of the frog in their second year of German medical school. At some universities frogs are still killed for this purpose. Others use video clips to show the preparation and to reduce the number of experiments. There are also some computer-simulations in use which did not spread widely, yet, because of their user-unfriendlyness and partly unphysiologic responses. "SimNerv" is based on an algorythm which completely simulates SAP's. It is integrated in a virtual lab consisting of a stimulation chamber, a stimulator and an oszilloscope. Students learn about nerve conduction velocity, refractory time, anodic and cathodic stimulation, monophasic and biphasic action-potentials and the effects of local anesthetics. The program has been evaluated on 250 students with only 2% who disliked the didactical approach.

INTRODUCTION

There is a controversial and ongoing debate in the medical community and in public on the use of animals for routine experiments in medical education. In some parts of Germany legal restrictions have been imposed lately to reduce the number of killed animals. The so-called "Froschversuch" on SAP's of the frog is the first animal-experiment in the physiology course of second-year medical students. More and more students refuse to take part in that course when they are told to kill an animal for their experiments. Videotapes have been used for a couple of years to demonstrate the preparation of the nerve. The number of experiments could subsequently be reduced to a few demonstration sites. A major disadvantage of this didactical approach is the passiveness of the watching student. As an alternative, computer-simulations are in use at some universities. These programs usually confront the student with a complex user-interface. Furthermore most of the programs are no true simulations but use scanned background images which pop-up on the ozcilloscope-screen under certain conditions.

STRUCTURE AND CONCEPT

Our program is used by 2 students working on one 14"-color monitor equipped computer. In the introductory part, the wild life of frogs is illustrated and frog sounds are implemented to make the student think of the animal as a whole in its natural surroundings. The second part depicts the preparation of the ischiadic nerve through 9 digital video-sequences ("QuickTime"®). The topographical anatomy and the crucial parts of the preparation are explained. At the end of this part, the nerv is ready to be taken into the stimulation chamber of the vitual lab being the core part of the application: An oszilloscope, a stimulator and a stimulation chamber are displayed and can be tuned and manipulated by the user like real devices. The results of stimulation experiments displayed on the screen of the oszilloscope are generated by an algorythm which is able to simulate virtually everything the real nerve does. This includes a wearing-out-phenomenon after excessive stimulation, different behaviour for every investigated nerve etc. The following phenomena can be looked at in random order: nerve conduction velocity, absolute and relative refractory time, dependance of SAP on stimulation amplitude, effects of local anesthetics, anodic and cathodic stimulation, and monophasic and biphasic action potentials. It seems important to emphasize, that each physiology teacher or individual user can determine himself, which experiments should be performed in which order. This makes the program accessible for a variety of different didactical approaches.

EVALUATION

The program has been evaluated on 250 students at the University of Marburg where it was used in the obligatory physiology course for second year medical students. Only 2% of the questioned students did not like the use of this computer program because they thought they would learn more by "touching the real tissue". All the other students either liked to work with the program (60%) or did not comment, because there was no comparison for them at hand (38%). The evaluation will be continued during the summer term 1993.

OUTLOOK

"SimNerv" is a virtual physiology lab for SAP's which is already used for training German medical students. It can replace the traditional experiments with living frogs and could serve as a model for further simulation-modules. A second program on the simulation of muscle contraction will be ready within one year. The goal to have a complete virtual physiology lab for the second year physiology-course in medical school will be pursued.

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